84- 3531 /

forest research note

1984 No. 36

Shoot Morphology of Winter-Damaged Black Spruce Container Seedlings

by

S.J. Colombo

Introduction

Winter damage to black spruce container seedlings can occur if seedlings are removed from the greenhouse for overwintering outside before they have developed sufficient frost hardiness. This type of damage usually occurs randomly throughout the crop. However, since environmental conditions within a greenhouse are usually quite uniform, the reasons for this randomness are not clear. This note describes and attempts to explain some variations in first-season shoot morphology which were associated with the occurrence of winter damage in a black spruce (Picea mariana (Mill.) B.S.P.) paperpot seedling crop.

Materials and Methods

Three trays containing in total about 1000 black spruce seedlings in FH408 Japanese paperpots were removed on April 15, 1982, from an overwintering bed of the Swastika Forest Station (48°06'N Lat., 80°06'W Long.). About 50% of the seedlings in each tray were damaged. The height growth, frost hardiness and bud development of this stock has been described elsewhere (Colombo 1982).

The seed originated from a Hearst District source (48°40' to 53°30' N Lat. and 83°16' to 85°15' W. Long.). Seeds were sown May 4, 1981, and the seedlings grown in a polyethylene-covered greenhouse until August 14, 1981, when they were moved outside.

A total of 35 damaged and 35 undamaged seedlings were randomly selected and examined. Seedling shoots were examined to assess the degree of winter damage (percentage of the stem containing dead needles), total shoot length, and the length and position of each lateral branch on the stem. Shoot length and lateral branch length data were analyzed using the t-test (Freese 1967).

Results and Discussion

Damaged seedlings were significantly taller (14.2 cm) than undamaged seedlings (12.1 cm) (Table 1). Similarly, lateral shoots were significantly longer for damaged than for undamaged seedlings (Table 1). For example, in the lower third of the stem of damaged seedlings, lateral shoots averaged 2.3 cm in length, whereas similar shoots on undamaged seedlings were significantly shorter, averaging 2.0 cm.

Ontario Ministry of Natural Resources

Hon. Alan W. Pope
Minister

John R. Sloan
Deputy Minister

Further information may be obtained from:

Ontario Tree Improvement and Forest Biomass Institute
Ministry of Natural Resources
Maple, Ontario L0J 1E0

TABLE 1 First-year height and lateral shoot length of winter-damaged and undamaged black spruce container seedlings

Seedling type	Height (cm)	Mean lateral shoot length (cm)		
		Portion of stem		
		Lower third	Middle third	Upper third
Undamaged	12.12	2.01	0.58	0.048
Damaged	14.23	2.33	0.84	0.057
Level of significance[a]	***	**	***	NS

[a]NS - not signficantly different (P<0.05)
** - significant at P<.01
*** - significant at P<.001

An earlier visual examination of seedlings revealed that a number of seedlings, randomly distributed in the trays, had retained succulent stems and continued height growth later in the fall of 1981. For example, on September 12, almost 40% of the seedlings were still growing in height, compared to 93% on September 5 (Table 2). Similarly, there was substantial variation in the date of budset, with 50% of the seedlings initiating buds by August 5, but bud initiation did not reach 100% until nearly two weeks later.

Bud initiation in one-year-old spruce seedlings occurs primarily in response to shortening daylengths. However, this response is known to be variable depending upon the latitude of seed origin (Vaartaja 1959, Heide 1974, Pollard et al. 1975). In Ontario, seed is usually defined by district only, and the variation found here in the cessation of shoot elongation may be a reflection of the latitudinal range of the seed collection area within Hearst District. It is possible that the taller seedlings, which suffered frost damage and which presumably set bud later, came from the southern part of the Hearst District, as southerly sources respond more slowly than northern sources to shortening daylengths in the fall (Vaartaja 1959, Heide 1974, Pollard et al. 1975).

High levels of frost hardiness are achieved sooner the earlier buds are initiated (Colombo 1982). It is suspected that taller seedlings with longer lateral shoots were damaged because they ceased growth later than the undamaged seedlings, and therefore were susceptible to frost damage later in the fall after being moved outside. Although taller seedlings may have been damaged because they were more exposed in the overwintering bed, neither tall nor short seedlings were damaged when seedlings of this same crop were hardened using Extended Greenhouse Culture, which allows all seedlings to become frost hardy before they are moved outside (Colombo 1982, Colombo et al. 1982).

TABLE 2 Percentage of black spruce container seedlings with active shoot elongation and bud initiation during hardening at the Swastika Forest Station (from Colombo 1982)

Date		Seedlings with active shoot elongation (n=60)	Bud initiation (n=20)
July	29	-[a]	50.0
Aug.	1	100.0	-[a]
	5	-	50.0
	8	100.0	-
	12	-	80.0
	15	100.0	-
	19	-	100.0
	22	100.0	-
	26	-	100.0
	29	100.0	-
Sept.	2	-	100.0
	5	93.3	-
	12	38.3	-
	19	15.0	-
	26	1.7	-

[a]-, not measured

Acknowledgement

The technical assistance of K.D. Odlum is gratefully acknowledged.

Literature Cited

COLOMBO, S.J. 1982. Winter damage to container seedlings: Consequences and prevention. In Proceedings of the Ontario Ministry of Natural Resources, Nurserymen's Meeting, Thunder Bay, Ontario, June 7-11, 1982. p. 10-24.

COLOMBO, S.J., C. GLERUM and D.P. WEBB. 1982. Bud development in black spruce container stock. Ontario Ministry of Natural Resources, Forest Research Note No. 32. 5 p.

FREESE, F. 1967. Elementary statistical methods for foresters. U.S. Dep. Agric., Forest Serv., Agric. Handb. 317. 87 p.

HEIDE, O.M. 1974. Growth and dormancy in Norway spruce ecotypes (Picea abies) I. Interaction of photoperiod and temperature. Physiol. Plant. 30: 1-12.

POLLARD, D.F.W., A.H. TEICH and K.T. LOGAN. 1975. Seedling shoot and bud development in provenances of Sitka spruce, Picea sitchensis (Borg.) Carr. Can. J. For. Res. 5: 18-25.

VAARTAJA, O. 1959. Evidence of photoperiodic ecotypes in trees. Ecol. Monogr. 29: 261-288.

5616-7
ISSN 0381-2650